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Broadband features of the shallow low frequency events in Nankai trough, excited after the 2011 Tohoku-Oki earthquake

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Low frequency events are seismic events, which have longer duration and less energy radiation compared to regular earthquakes. The low frequency events detected in the shallow part of the Nankai trough (depth<10km), reported by previous studies, can roughly be divided into two groups depending on the observable frequency ranges of the signal, where the frequency ranges actually depend on the observed instrument.

The events of the first group are very low frequency earthquakes (VLFE), which were originally detected by broadband seismographs on-land (Ishihara et al., 2003; Ito & Obara, 2005), dominant in the frequency around 0.1-0.05 Hz. More recently a close-in observation was successfully made by temporally deployed broadband ocean-bottom seismometers (BBOBS), which revealed many intriguing features of the VLFEs (Sugioka et al., 2012). The events of the second group are low frequency tremors (LFT), which are recorded by OBSs equipped with 4.5?Hz short-period seismometer sited close to the source regions. They are dominant in the frequency range of 2?8 Hz with a lack of energy above 10 Hz (Obana & Kodaira, 2009). The classification between LFTs and VLFEs must be an important step toward estimating the physical process of the shallow low frequency events.

After the 2011 Mw9.0 Tohoku-oki earthquake, many shallow low frequency events were recorded at a cabled network of ocean bottom broadband stations (DONET) deployed in the northern part of Nanakai trough. The characteristics of the events are similar to previously observed LFTs at the frequency range around 2-8Hz. In addition, some of the events are accompanied by a lower frequency signal, clearly visible around 0.02-0.05 Hz, whose features are similar to those previously observed as VLFEs by Sugioka et al.(2012). One of such features of VLFEs is the ramp-type motion of the instrument-corrected seafloor displacement, which corresponds to a subsidence of up to 0.04 mm with a rise time of 10-20 s.

In order to examine whether the events accompanied by the 0.02-0.05Hz signal are intrinsically different from those without the 0.02-0.05Hz signal, the amplitudes of each event measured at 2-8Hz and 0.02-0.05Hz are compared. The comparison shows that the events without the 0.02-0.05 Hz signal tend to have lower amplitude in 2-8Hz than those accompanied by the 0.02-0.05 Hz signal. The result indicates that there is no such event, which is intrinsically missing the 0.02-0.05Hz components but has large amplitude in 2-8Hz. In other words, the events without the 0.02-0.05Hz signal are likely to be either smaller in size or to have occurred further away from the stations, compared to the events accompanied by the 0.02-0.05 Hz signal. Our dataset shows that the two types of low frequency events are likely the same phenomenon.

Keywords: very long frequency earthquake, low frequency tremor